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FRAGMENTS FROM THE CHALAZAL END OF THE COTTON SEED -

Their Formation and Factors Affecting Extent of Presence in Ginned Lint

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INTRODUCTION

The spinning quality of ginned cotton lint is a composite of numerous lint and fiber properties that affect: (1) the quality of yarn into which the lint is to be spun; (2) the amount of visible waste during manufacturing; and (3) the cost of manufacturing.

Most ginned lints contain, in various numbers and sizes, motes, fragments of motes that were crushed during ginning, and fragments from mature seeds along with other foreign matter. All of these structures, if present in the lint in considerable numbers, have an adverse effect on its spinning quality.

1/ This study is part of the program of work on cotton quality and standardization research under the leadership of Robert W. Webb, principal cotton technologist, Agricultural Marketing Service.

Motes, mote fragments, and seed fragments constitute waste that should be removed during manufacturing. But small seed and mote particles, because of their attached fibers (fig. 1, A), cling to the lint tenaciously and are exceedingly difficult to eliminate (3), (5), 2/ and some may cling persistently throughout the manufacturing processes and become incorporated in the yarn. These small particles that are not eliminated may be either particles that were present as such in the ginned lint or pieces from larger seed and mote particles or from entire motes that were crushed and broken during carding (5).

The seed-coat fragments that become incorporated in the yarn produce imperfections in the form of knotty bulges or brown specks (fig. 1, E, F), and if the cloth is to be dyed, the fibers attached to the seed coat may present an additional problem; that is, as do neps (3), they may sometimes dye either darker or lighter than the surrounding background.

The resemblance of seed-coat fragments, when incorporated in the yarn, to neps, leaf, and similar small imperfections, has often masked their real identity and has thus prevented their recognition as a factor of yarn quality. Persons rather closely associated with cotton manufacturing often incorrectly call them neps, leaf, trash, etc. Moreover, in bleaching, the seed-coat portion is sometimes dissolved away (3) leaving the fiber portion as an irregularity that readily could be mistaken for a nep.

A preliminary study has shown that lints differ in the number of seed fragments, motes, and mote fragments present. Furthermore, studies of various lots of yarn have shown that they likewise differ in the number of small seed-coat fragments present.

In connection with the experimental cotton ginning and spinning programs of the United States Department of Agriculture 3/, which include an investigation of the factors affecting the spinning quality of cotton lint, it is desirable to understand how seed and mote fragments are formed during ginning and what factors affect the extent to which seed fragments, motes, and mote fragments occur in the lint.

2/ Underlined numbers in parentheses refer to Literature Cited, p.34.

3/ The experimental ginning program is being conducted jointly by the Bureau of Agricultural Chemistry and Engineering and Agricultural Marketing Service, in cooperation with the Delta Branch Experiment Station, Stoneville, Miss.; the experimental spinning program is being conducted at the cooperative cotton spinning research laboratories at the Clemson Agricultural College, Clemson, S.C. and the A. & M. College of Texas, College Station, Texas.

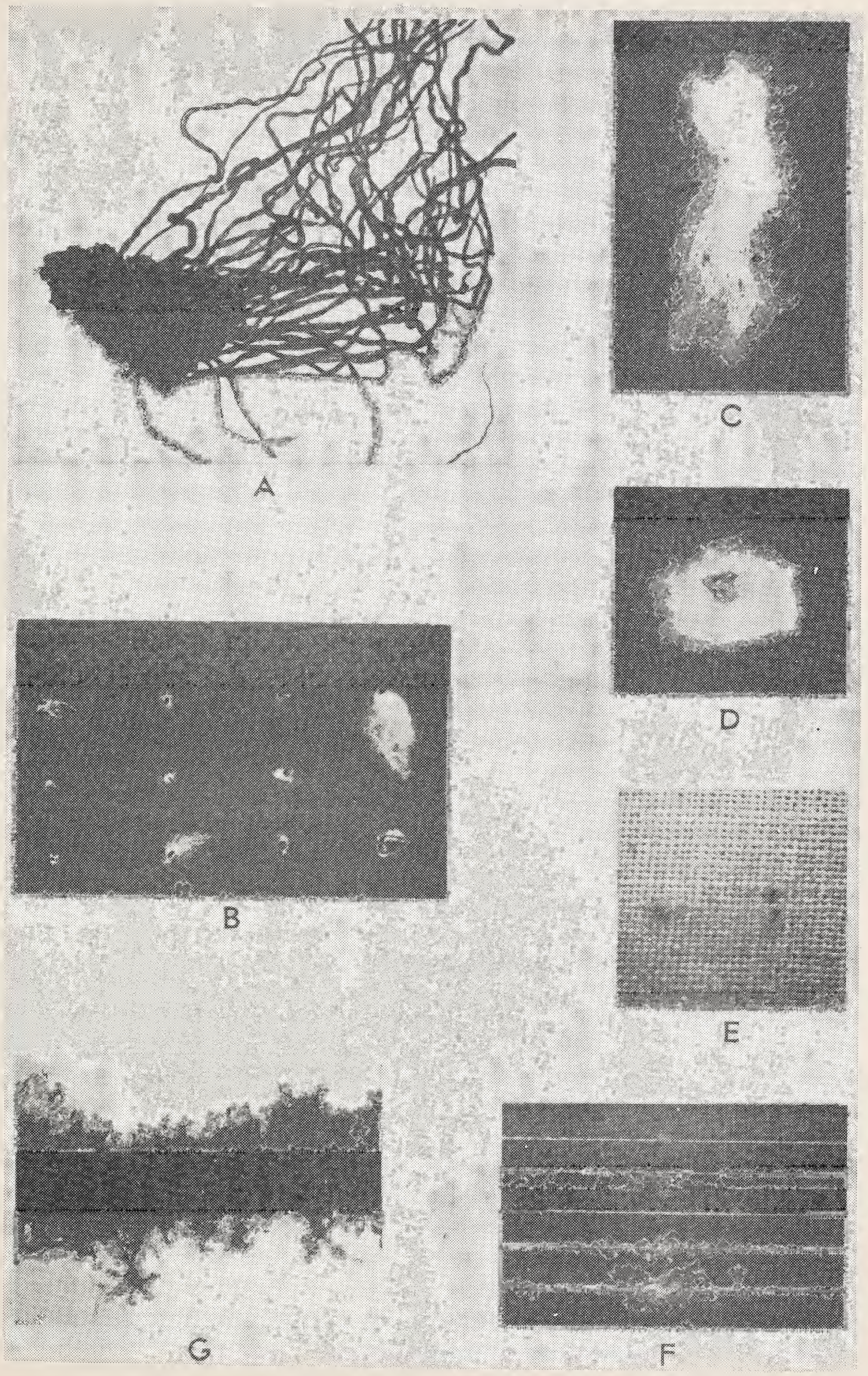

Figure 1.--A, small seed-coat fragment, x 60. B, seed-coat fragments in ginned lint, natural size. C, chalazal fragment, x 3. D, chalazal end of a seed from which a fragment of the seed-coat has been broken away, x 3. E, seed-coat fragments in cloth, x 3-1/2. F, seed-coat fragments in yarn, x 2-1/2. G, portion of chalazal tissue of the cotton seed coat, showing spongy cells, x 160.

This paper is concerned with only one type of seed fragment that occurs in ginned lint, the fragment from the chalazal or rounded end of the seed.

The work of the authors proceeded along three main lines of investigation in order (1) to ascertain the manner in which chalazal fragments are formed; (2) to study the effect of certain factors associated with ginning upon the number of these fragments in ginned lint; and (3) to study the potentialities of different cotton seeds for yielding chalazal fragments.

GENERAL DESCRIPTION OF THE SEED COTTONS USED AND THE SAMPLING PROCEDURE

The materials used in these studies were obtained from the cotton ginning laboratory and from the Bureau of Plant Industry laboratory at Stoneville, Mississippi.

The materials received from the cotton ginning laboratory included samples of seed cotton, ginned lint, and seeds from certain of the regular ginning tests of this laboratory. The seed cottons employed in these ginning tests are described briefly in table 1. They were originally obtained by the ginning laboratory through cooperation with certain State experiment stations, cotton breeders, "increase parties," and growers (1), (2). The manner in which the ginning tests were conducted is described fully in Technical Bulletins No. 503 and 508.

The sampling procedure, in brief, was as follows: Seed-cotton samples were taken at the time of ginning each particular lot, and portions of these samples were used to ascertain the moisture content of the cotton at the time of ginning, the remainder being reserved for use in subsequent studies; samples of ginned lint and ginned seed were taken (2, p. 10) "during each test after the desired condition had been acquired and maintained for a short period of time." From these ginning test samples, smaller samples were then taken for use in the studies described in this paper.

The small samples of ginned lint and ginned seed, and certain of the seed cotton samples were made by taking small portions from at least 12 places throughout the larger ginning-test samples. Some of the seed-cotton samples were taken directly from the wagon when it arrived at the gin, and some were taken from the field.

Tests were made on a series of samples to ascertain what size of small ginned-lint samples should be used. It was found by counting the number of chalazal fragments contained in duplicate samples of lint from several different lots used in ginning tests that samples weighing 1-1/2 ounces each, made by taking pinches from 12 different places on the large sample (table 2), showed little difference in the number of chalazal fragments contained. An average of the standard

Table 1.-- A partial description of the seed cottons used in the tests

Cotton lot number	Variety	Where grown	Harvesting		Staple length (classer's)
			Date	Stage	
					Inches
36	Delfos #4	Stoneville, Miss.	Sept.8-9,1931	1	1-3/16
51	Missdel #3	" "	" 29-30,"	1	1-7/32
105	Delfos #531	" "	Aug. 22, 1932	1	1-3/16
112	Acala	Blytheville, Ark.	Sept. 1, 1932	1	1-1/32
115	Stoneville #2	Griffin, Ga.	Sept.5-6, "	1	1-1/32
118	Delfos #531	Stoneville, Miss.	Sept.12-13,"	2	1-3/16
120	D.P.L. 4-8	Belle Mina, Ala.	Sept. 3-11,"	1	31/32
131	D.P.L. 4-8	" " , "	" 25, "	2	15/16
133	Harper Certified	Britton, Texas	Oct. 1, "	1	31/32
135	Delfos #531	Stoneville, Miss.	Sept.28-30,"	3	1-1/8
136	Coker #5	Clemson College,S.C.	" 21-30,"	2	1-3/32
144	Delfos #531	Stoneville, Miss.	Oct. 24-25,"	3	1-1/8
202	" "	Greenville, Miss.	Aug.15-16, 1933	1	1-3/16
217	Stoneville #2 A	Magenta, Miss.	Sept. 7, 1933	1	1-5/32
221	Wilson Type	Wilson, Ark.	" 8, "	1	31/32
301	Stoneville #2 A	" "	Aug. 27, 1934	1	1-3/32
305	Missdel #3	" "	Aug.30-31, "	1	1-5/32
307	Cook #307	Prattville, Ala.	Aug. 31, 1934	1	13/16
310	Delfos #2	Stoneville, Miss.	Sept.3-4-5,1934	1	1-5/32
311	Delfos #531	Greenville, Miss.	" 5-6, 1934	1	1-3/16
313	" "	" "	" 6, 1934	1	1-5/32
314	Qualla	Britton, Texas	" 4-5, 1934	1	15/16

Continued

Table 1.--A partial description of the seed cottons used in the tests--Continued

Cotton lot number	Variety	Where grown	Harvesting Date	Harvesting Stage	Staple length (classer's)
					Inches
317	Wilson Type Big Boll P	Wilson, Ark.	Sept. 10, 1934	1	15/16
323	Delfos #4	Stoneville, Miss.	" 11, 1934	1	1-1/8
325	Missdel #3	Australia Is., La.	" 17-18, 1934	1	1-5/32
353	Ambassador #4	Hayti, Mo.	" 19, 1934	1	1-1/32
403	Kasch	Edroy, Texas		2	1-1/32
405	Stoneville #2 B	Stoneville, Miss.	Aug. 14, 1934	1	1-1/8
406	Stoneville #2 A	" "	Aug. 17, 1935	1	1-5/32
410	Delfos #9252	Hollyknowe, Miss.		1	1-5/32
411	Arkansas Rowden #40	Montrose, Ark.	Aug. 24, 1935	1	1
412	Delfos #6	Stoneville, Miss.	Aug. 28, 1935	1	1-1/8
414	Missdel #3	" "	Aug. 27, 1935	1	1-5/32
417	Cook #307-92	Prattville, Ala.	Aug. 29, 1935	1	7/8
419	Deltapine	Stoneville, Miss.	Aug. 30, 1935	1	1-1/8
424	Missdel #3	Australia Is., La.	Aug. 15, 1935	1	1-3/16
427	Delpress	Stoneville, Miss.	Sept. 2, 1935	1	1-5/32
434	Farm Relief	Shorter, Ala.	Aug. 12-14, 1935	1	1-1/8
438	Dixie Triumph	Baton Rouge, La.	Aug. 25, 1935	1	31/32
441	Missdel #3	Stoneville, Miss.	Sept. 12, 1935	1	1-1/8
443	Delpress #3	" "	" 13, 1935	1	1-5/32
469	Meade	Robinsonville, Miss.	" 15, "	1	1-3/16
481	Deltapine	Stoneville, Miss.	" 30, "	1	1-1/16

Table 2.--Chalazal fragments in duplicate 1-1/2-ounce samples of lint taken from ginning test samples of eight different cottons

Cotton lot number	Chalazal fragments in 1-1/2-ounce samples			
	Sample 1	Sample 2	Average	Standard error of the mean
	Number	Number	Number	Percent
301	40	33	36½	9.59
305	21	22	21½	2.33
307	234	285	259½	9.83
313	10	7	8½	17.65
314	17	26	21½	20.93
317	66	66	66	0.0
323	7	8	7½	6.67
325	19	18	18½	2.70
				Av. 8.71

errors expressed as percentages of the means indicated that on the whole, a precision of + or - 12.3 percent ($8.71 \times \sqrt{2}$) could be expected when a single 1-1/2-ounce sample was used. In view of the apparently large differences between cottons, a precision of this degree seemed sufficient for the purposes of this study. All data as to the number of chalazal fragments in ginned lint referred to in this paper were obtained by counting the number of chalazal fragments in these 1-1/2-ounce samples. In making the counts, small portions of the lint were taken from the sample, gently teased apart with forceps over a black background, and the seed-coat fragments removed and counted.

The materials obtained from the laboratory of the Bureau of Plant Industry were seed cotton samples from the 16 varieties of the Regional Variety Test grown at Stoneville, Mississippi, together with samples from a cotton designated in tables 9 and 10 as Cotton A. These samples consisted of entire bolls, the size of the sample depending upon the nature of the test for which the material was intended. The bolls were selected from the field, and from about the middle of the plant.

Since the specific materials and the testing procedures differ decidedly for the three divisions of this investigation, materials and methods employed in each study will be described in detail for each division.

DESCRIPTION AND FORMATION OF CHALAZAL FRAGMENTS

Materials and Methods

The materials used were samples of ginned lint and ginned seed from tests in which roller-, hand-, and saw-ginning methods were employed.

Lint samples representing the three methods of ginning were carefully examined for types of seed-coat fragments present, and these fragments were studied both macroscopically and microscopically in order to ascertain their source (whether from motes or seeds) and their probable method of formation.

The ginned seeds from roller-, hand-, and saw-ginning tests were examined for cuts, scars, etc.

Observations and Conclusions

Ginned lint may contain seed and mote fragments of various sizes and shapes and with various amounts of short or long fibers attached (fig. 1, B). There is one type of seed-coat fragment, however, that comes from the chalazal or rounded end of the seed (fig. 1, D). This fragment is characterized by a bit of dark-colored seed coat to which a tuft of long fibers is attached (fig. 1, C). The term "chalazal fragment" will be used to describe these fragments and distinguish them from other seed-coat fragments.

There is some possibility that these chalazal fragments may be confused with fragments of similar size from motes that have been crushed during ginning or from portions of seeds other than the chalazal end. Identification, however, can usually be made macroscopically, by the general appearance of the fragments, and microscopically, by certain fiber and seed-coat characteristics.

The general appearance of chalazal fragments--the dark-colored seed-coat particles to which are attached fairly compact tufts of long fibers (fig. 1, C)--is usually sufficiently characteristic to serve to distinguish them from fragments from motes that have been crushed during ginning. Certain distinct properties of mote fragments also will aid in differentiation from chalazal fragments. Fragments from motes that are large enough to be crushed during ginning are characterized by the light color of the partially developed seed coat and by the silky, exceedingly thin-walled fibers, in contrast with the dark-colored seed-coat and the thicker-walled fibers of the chalazal fragments. Moreover, since motes are only partially developed seeds, the seed-coat particle will show, upon microscopic examination, only a partial development of the tissues that are characteristic of the mature seed coat.

The general appearance of chalazal fragments, particularly the presence of the fiber tuft itself, usually will serve to distinguish them from fragments from portions of the mature seed other than the chalazal end. Chalazal fragments appear to possess all, or at least most, of the fibers that were originally attached to the bit of seed coat, whereas fragments cut from portions of the seed other than the chalazal end, in general, possess either no tuft of long fibers or a tuft which usually covers only a portion of the seed-coat particle.

One particular characteristic of the chalazal portion of the seed coat will also aid in the identification of chalazal fragments. The tissue underlying the chalazal epidermis is spongy (4) in contrast to the compact tissue at other portions of the seed coat. Because of the spongy tissue, the seed-coat portion of chalazal fragments is usually more brittle than the seed-coat particles from other portions of the seed. Moreover, if a microscopic examination of a fragment reveals the presence of ragged, spongy cells (fig. 1, G) the fragment can be definitely identified as coming from the chalazal end of the seed.

Lint may contain some very small fragments with only a few short fibers attached that are from the chalazal end of the seed coat. Some of these fragments are probably small particles that have become separated from the larger fragment; possibly others have been cut or broken directly from the seed. Since these particles are so very small, in comparison with the fragments that carry the tufts of long fibers, they were not considered when the chalazal-fragment counts were made. All fragments referred to throughout the discussion as "chalazal fragments" are fragments to which definite tufts of long fibers were attached.

The chalazal fragments may vary somewhat in the size of the seed-coat particles and consequently in the size of the fiber tufts.

Since the chalazal portion of the seed coat is very brittle, it occasionally happens that the seed-coat portion from one seed may be in several parts. But the presence of a single, fairly compact tuft makes it evident that all come from one seed and so for the purpose of this study, the entire mass is considered as one fragment.

At first thought it would seem logical to assume that the seed fragments present in saw-ginned lint arose from the cutting and breaking of the seeds by the teeth of the gin saw; but the seed fragments with the tufts of long fibers attached are found in both roller-ginned and hand-ginned lint as well as in saw-ginned lint.

A study of ginned seeds from cotton that had been hand-, roller-, and saw-ginned showed that some of the seeds from each of the three groups had scars at the chalazal ends, indicating that fragments had been broken from this region during ginning.

Furthermore, the formation of such fragments can be observed during the process of hand ginning. Frequently during this procedure a portion of the seed coat, with its tuft of long fibers attached, will be broken from the chalazal end of the seed when an attempt is made to remove the fibers from this portion (fig. 1, C, D).

These observations prove that such fragments can be formed by a pull on the chalazal tuft of fibers, and the presence of these fragments in roller-ginned and hand-ginned lint indicates that their formation is not caused primarily by a tooth of a gin saw striking the seed coat.

The spongy character of the chalazal tissue undoubtedly weakens the seed coat and it would seem that the force necessary to detach the fibers is sometimes more than sufficient to rupture the seed coat. As a result, fragments with their fibers still attached are pulled from some seeds during ginning.

The breaking or pulling off of fragments from the chalazal end of the seed will be referred to hereafter as "chalazal chipping."

EFFECT OF CERTAIN FACTORS ASSOCIATED WITH GINNING UPON THE PREVALENCE OF CHALAZAL FRAGMENTS IN GINNED LINT

In connection with the ginning research being conducted by the United States Department of Agriculture Ginning Laboratory at Stoneville, Mississippi, a study was made to ascertain whether drying seed cotton prior to ginning, and the seed-roll density and the gin-saw speed employed during ginning are factors affecting the prevalence of chalazal fragments in the ginned lint.

Materials and Methods

Ginned lint samples from certain of the ginning tests performed at Stoneville, Miss., were used in these studies. Conclusions as to the effect of the different ginning factors upon the number of chalazal fragments in ginned lint are based upon data secured by counting the number of chalazal fragments in 1-1/2-ounce lint samples.

Fourteen cottons (tables 1 and 3), ranging in staple length from 15/16 inch to 1-7/32 inches, were employed in studying the effect of drying harvested seed cotton prior to ginning upon the number of chalazal fragments in the ginned lint. These cottons were handled in the manner described by Gerdes and Bennett for their cotton drying experiments (2), and 10 of the 14 cottons are among those included in the test described by these authors (2). Since the details of the experiments are described fully in Technical Bulletin No. 508 (2), only a brief outline of the procedure need be given here.

Each lot of seed cotton to be tested was divided into several portions. A portion from each lot was ginned without drying, or "as is," and the other portions were dried either in the vertical seed-cotton drier (2) at each of several temperatures, or by means of sun-drying and by storing for various periods of time (table 5). For several cottons, three different portions were dried in the vertical seed-cotton drier, one at each of three temperatures: 150° F., 200° F., and 250° F. Each successively higher temperature usually reduced the moisture content of the seed cotton below that of the portion dried at the lower temperature. In a few instances, a portion was sent through the drier twice. The moisture content of the portion dried twice was lower than that of the portion dried once. As a rule, the sun-dried and stored portions had lower moisture contents than did the corresponding portions dried in the vertical drier. A part of each differently conditioned portion was ginned with a loose seed roll and a second part with a tight seed roll. 4/

Three cottons were employed to study the effect of allowing cotton to dry naturally in the field after there had been an especially heavy dew. For each of these cottons, one lot was picked in the early morning in a dew-laden condition and ginned while damp; a second lot was picked from the same field in the afternoon of the same day and ginned immediately after picking.

The effect of the rate of saw speed was studied on three cottons. The saw speeds employed ranged from 300 to 700 revolutions per minute. A detailed description of the ginning tests themselves may be found in Technical Bulletin No. 503 (1).

Observations and Conclusions

The Effect of Drying Seed Cotton Prior to Ginning

For each seed cotton studied, all of the conditioned lots had a somewhat lower moisture content than the corresponding green

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4/ In some instances only the lot ginned with a loose seed roll was studied.

Table 3.--Percent of moisture at the time of ginning in green or "as is" and in conditioned portions of 14 different seed cottons

Cotton lot number	Green or "as is" portions	Conditioned portions									
		Dried in vertical drier							Dried in horizontal drier	Stored	Sun-dried
		150° F.		185° F. 190° F.	200° F.		250° F.				
		1 1/	2 2/		1 1/	2 2/	1 1/	2 2/			
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
36	18.8	15.8 10.2 3/									11.5
51	7.2	4.7							4.4	6.9	
105	16.4	14.2			13.6		13.5	11.2		10.7	7.6
112	15.0	13.6			13.2		13.0	12.2			
115	11.7	9.6	9.0		9.9	9.0	9.8	8.8			6.6
118	9.6				8.7						
120	14.4	12.5			11.2		11.4	10.9			
131	16.2	12.4			12.5		11.6	10.3			
133	13.7	12.4			12.0		10.7				
144	11.4				9.7						
202	17.5			15.9							5.4
217	20.2			15.6							6.8
221	24.4			21.8							12.3
301	15.1										4.9

1/ Seed cotton passed through the vertical drier once
2/ Seed cotton passed through the vertical drier twice
3/ Both sun-dried and dried in the vertical drier

or "as is" lots (table 3). Also, there was a general tendency for the moisture content of the different lots to become progressively lower as higher drying temperatures or longer drying periods (sun-drying or storage) were employed. In practically every case there was considerable difference in the moisture content of the green or "as is" seed cotton and the lot having the lowest moisture content. Thus, comparisons for each cotton, between the number of chalazal fragments in the lint ginned from the green or "as is" portion and the lint from the portion having the lowest moisture content after conditioning, should give reliable evidence of the effect of removing moisture from the seed cotton previous to ginning upon the number of chalazal fragments in the ginned lint.

In 18 out of 21 such comparisons (14 paired samples ginned with a loose seed roll and 7 paired samples ginned with a tight seed roll) it was found that the lint from the portion of seed cotton having the lowest moisture content after conditioning contained fewer chalazal fragments than did the lint from the corresponding green or "as is" portion (portion having the highest moisture content) (table 4).

The data for loose seed roll only (table 4) were subjected to covariance analysis. Because of the variations between cottons in the number of chalazal fragments in the ginned lint, a straight correlation analysis of the data would not reveal the true correlation between moisture content of the seed cotton and the number of chalazal fragments in the ginned lint. By applying covariance analysis, the variation due to varietal differences can be segregated from variation due to moisture content, and the true correlation between moisture content and the number of chalazal fragments in the lint can be shown. Covariance analysis gave a correlation coefficient of 0.919, whereas values of only 0.514 or 0.641 are required for 5 percent and 1 percent levels of significance, respectively. These results indicate that for a given cotton, high moisture content of the seed cotton at the time of ginning was closely related to a high number of chalazal fragments in the ginned lint, and low moisture content closely related to a low number of fragments.

The results for portions of intermediate moisture content (not included in the results shown here) were less consistent but showed the same general relationship between percentage of chalazal fragments in the lint and the moisture content of the seed cotton at the time of ginning. Chalazal fragments were counted in lint samples from 43 such portions and 27 contained fewer chalazal fragments than did the lint ginned from the undried seed cotton.

The effect of allowing damp seed cotton to dry before ginning upon the prevalence of chalazal fragments in the ginned lint was also brought out in a study of lint ginned from early morning and afternoon pickings from the same field. The lots picked early in the morning before the dew had dried and before the freshly opened bolls had had an opportunity to dry, had, with one exception, a much higher moisture content than did the afternoon pickings (table 5). The lots were ginned immediately after picking and in every instance the lint ginned from the morning picking

Table 4.--Number of chalazal fragments in lint from dried and undried portions of the same seed cotton ginned with a loose and with a tight seed roll

Cotton lot number	Treatment of seed cotton	Moisture content of seed cotton	Chalazal fragments in 1-1/2-ounce samples of ginned lint 1/	
			Loose seed roll	Tight seed roll
		Percent	Number	Number
36	Undried	18.8	59	62
	Dried	10.2	5	10
51	Undried	7.2	19	9
	Dried	4.7	25	37
105	Undried	16.4	113	55
	Dried	7.6	11	20
112	Undried	15.0	63	94
	Dried	12.2	37	25
115	Undried	11.7	17	20
	Dried	6.6	10	13
118	Undried	9.6	16	
	Dried	8.7	10	
120	Undried	14.4	123	79
	Dried	10.9	103	88
131	Undried	16.2	104	
	Dried	10.3	66	
133	Undried	13.7	41	50
	Dried	10.7	26	26
144	Undried	11.4	5	
	Dried	9.7	4	
202	Undried	17.5	65	
	Dried	5.4	14	
217	Undried	20.2	78	
	Dried	6.8	8	
221	Undried	24.4	126	
	Dried	12.3	15	
301	Undried	15.1	55	
	Dried	4.9	10	

1/ Covariance analysis of the loose seed roll data gave for the correlation within varieties between moisture content of the seed cotton and number of chalazal fragments in the ginned lint, a coefficient of correlation = 0.919 - values of 0.514 (5%) or 0.641 (1%) needed for significance.

Variance analysis of data representing number of fragments in lint ginned with a loose and with a tight seed roll (tables 4 and 6) gave: for means of different roll densities - F found = 1.99 - F needed = 250.00 (5%) or 6258.00 (1%); for means of cottons - F found = 10.24 - F needed = 1.85 (5%) or 2.41 (1%).

Table 5.--Number of chalazal fragments in ginned lint from cotton picked in the morning when dew-laden and cotton picked from the same field in the afternoon of the same day.

Cotton lot number	Time of picking	Moisture content of the seed cotton	Chalazal fragments in 1-1/2 ounces of lint
		Percent	Number
441	Morning	13.3	58
	Afternoon	8.7	34
443	Morning	14.8	47
	Afternoon	13.2	20
481	Morning	15.8	59
	Afternoon	8.1	24

contained about twice as many chalazal fragments as did the lint ginned from the afternoon picking (table 5).

It seems reasonable to conclude that drying (either naturally or artificially) green or damp seed cotton before ginning decreases the extent to which seeds are likely to chip at their chalazal ends during ginning.

Effect of Seed-Roll Density

The density of the seed roll appears on superficial observation to have some slight effect upon the extent to which seeds are chipped at the chalazal end during ginning. Out of 43 comparisons which it was possible to make from all the lots studied (tables 4 and 6), in 31 instances the lint from the cotton ginned with a tight seed roll contained more chalazal fragments than did the lint from the corresponding lots ginned with a loose seed roll. But in some instances the differences are very small and when the combined data of tables 4 and 6 were subjected to variance analysis there was shown to be no significant difference between the number of chalazal fragments in lint ginned with a loose seed roll and lint ginned with a tight seed roll (table 4).

Table 6.--Number of chalazal fragments in lint from seed cottons ginned at different rates of saw speed

Cotton lot number	Moisture content of seed cotton	Saw speed (revolutions per minute)	Chalazal fragments in 1-1/2 ounces of ginned lint 1/	
			Loose seed roll	Tight seed roll
	Percent	Number	Number	Number
135	10.4	300	7	16
		400	10	9
		500	2	13
		600	7	28
		700	2	17
136	11.0	300	16	37
		500	25	24
		700	34	46
36	18.8	350	67	77
	18.8	500	59	62
	15.8	350	34	43
	15.8	500	58	65
	11.5	350	30	25
	11.5	500	15	30
	10.2	350	14	15
	10.2	500	5	10

1/ Partial correlation coefficient for relationship between saw speed and number of chalazal fragments in the ginned lint for loose seed roll = 0.103; for tight seed roll = 0.256

Effect of the Gin-Saw Speed

Lint samples from saw-speed tests on three different cottons were studied (table 6).

A partial correlation analysis was undertaken of the number of chalazal fragments in the ginned lint as influenced by saw speed and a partial correlation coefficient of 0.103 was obtained for loose seed roll and 0.256 for tight seed roll. From this it is evident that, for the data presented in table 6, there is little or no influence of saw speed upon the number of chalazal fragments in the ginned lint.

DIFFERENCES IN THE CHIPPING POTENTIALITIES OF COTTON SEEDS AS DETERMINED BY HAND GINNING TESTS

From the foregoing study of ginned lint, it has been concluded that green seed cotton ginned without drying yields a lint with more chalazal fragments than does the same seed cotton ginned after drying.

Moreover, it may be observed (tables 2, 4, 5, and 6) that lints similarly ginned from different seed cottons having practically the same moisture content at the time of ginning, differ in the number of chalazal fragments contained. Thus the seeds from different seed cottons must differ in their tendencies to chip during ginning. And it is also evident that in any one seed cotton, seeds differ among themselves in their chipping potentialities. This is particularly noticeable when detaching fibers from the seed by hand. Some seeds will chip easily at the chalazal end whereas other seeds chip only under the roughest treatment.

Because of these very evident variations in the tendencies of seeds to chip at their chalazal ends during ginning, it seemed desirable to accumulate more extensive information concerning the chipping potentialities of specially selected cotton seeds. Accordingly, studies were conducted to ascertain the chipping potentialities of seeds (1) having different moisture content; (2) from different positions in the lock; (3) from different varieties.

Materials and Methods

In order to carry on investigations concerning the chipping potentialities of cotton seeds, a method of hand ginning that could be more or less standardized was developed. The fibers on the seed to be tested were divided into two tufts by parting the fibers along the raphe and along a line roughly parallel to the raphe on the opposite of the seed. Each tuft was grasped between the thumb and first finger of one hand (similar to stapling), and the portion of each tuft covering the chalazal region and the chalazal end of the raphe, was detached from the seed by a steady, even pull. If a seed chipped at its chalazal end during the treatment, this behavior was considered to indicate the possibility that that seed might chip during ginning.

It was found that the number of seeds that chipped during this testing procedure was larger than the number of chalazal fragments occurring in the lint ginned from an equal quantity of seed cotton (table 7). This discrepancy may be due, in part, to the fact that some chalazal fragments do not pass into the lint but are discarded with the mote trash. But a certain amount of discrepancy is to be expected, since in hand testing each seed is given the maximum opportunity for chipping, a condition that undoubtedly does not exist for every seed in the seed roll. Thus, these tests give the maximum chipping that might be expected in machine ginning, rather than what actually occurs.

For certain of the tests it was desirable to ascertain the chipping tendencies for seeds at different positions in the lock. For this purpose the seeds of the lock were separated into three groups on the basis of their position at the tip, middle, and base of the lock. This procedure was complicated, however, by the fact that all locks do not contain the same number of seeds, and therefore cannot be divided identically. To facilitate grouping, the seeds in

Table 7.--Number of chalazal fragments in 1-1/2-ounce samples of ginned lint as determined (1) by calculations based on the number of seeds that chipped in hand ginning and (2) by actual counts of fragments in machine-ginned lint

Cotton lot number	Weight of lint per 100 seeds 1/	Number of seeds necessary to produce 1-1/2 ounces of lint	Seeds chipped	Chalazal fragments per 1-1/2 ounces of lint 2/	
				Calculated from no. of chipped seeds 3/	Actually counted in lint
	Grams	Number	Percent	Number	Number
311	3.53	1205	1.3	15.7	10
323	5.08	837	2.8	23.4	7½
314	6.88	618	3.9	24.1	21½
325	5.60	759	5.2	39.5	18½
305	5.88	723	8.1	58.6	21½
301	5.32	799	9.6	76.7	36½
317	5.22	815	11.9	97.0	66½
353	5.60	759	15.2	115.4	63

1/ Average of 5 tests

2/ Seed cottons were of practically the same moisture content at time of ginning

3/ Calculated number of chipped seeds in 1-1/2 ounce sample: $\frac{\text{42.52 grams (1-1/2 oz.)}}{\text{wt. of lint from 100 seeds}}$ x percent of chipped seeds

the lock were numbered as described by Rhea (6). Each lock is composed of two rows of seeds, the seeds in one row alternating with those in the other. Thus, no two seeds are actually the same distance from the base of the lock. The seeds were numbered inversely according to their distance from the base of the lock, the seed at the tip being designated as No. 1 and each succeeding seed accordingly.

Most locks contain 7, 8, 9, or 10 seeds, although locks with a smaller or larger number of seeds do occur. In locks having 9 and 10 seeds, the seeds were grouped as follows: 1 + 2 + 3, 4 + 5 + 6, 7 + 8 + 9 and 10, for tip, middle, and base, respectively. In locks with 8 seeds or less, the first two seeds were considered the tip, and the last two seeds the base, all other seeds being grouped as of the middle of the lock.

Using the above described technique, tests were made of seed-cotton samples representing different moisture content, different varieties, and different positions in the lock. The samples were selected directly from the field or from the wagon lot at the gin.

In many of the tests there were variations in the number of seeds tested, although the original samples contained equal numbers of bolls or locks. These variations in number are due to the occurrence of motes and to irregularities in the number of seeds in the selected locks, and to variation in the number of locks per boll.

Description of Tests, Observations, and Conclusions

Differences in Chipping Potentialities of Seeds of Different Moisture Content

Two series of tests were made to ascertain the effect of the percentage of moisture in the seeds upon their tendencies to chip. The first series was performed to ascertain the chipping potentialities of seed-cotton lots representing the extremes of moisture content most likely to exist in harvested cotton. Fifty open but green bolls were selected from the field for each of four different cottons. The seeds were still soft, and some green color remained in the burrs and bracts. From each of these bolls two alternate locks were chosen for immediate study, and the other two or three locks were left in the boll to dry out in the laboratory from three to five weeks before testing. All of the mature seeds in the selected locks were tested for chalazal chipping.

For each of the four cottons studied, the percentage of chalazal chipping was decreased approximately one-half by allowing the green seed cotton to dry before testing (table 8).

In the second series of tests a study was made of the chipping potentialities of seeds during their gradual drying out in the boll, the percentage of chalazal chipping being correlated with the actual moisture content of the seeds. Bolls for each of two cottons were

Table 8.--Percentage of chalazal chipping, as determined by hand ginning, for green and dried lots of seed cotton

Variety of cotton	Green lot of seed cotton		Dried lot of seed cotton	
	Seeds tested	Seeds chipped	Seeds tested	Seeds chipped
	Number	Percent	Number	Percent
Rowden #2088	1024	40.1	1028	22.3
Mexican Big Boll	845	29.9	930	14.5
Farm Relief	803	32.1	953	11.5
Half and Half	932	43.3	1030	23.5

selected from the field to represent four arbitrarily selected stages of opening: (1) just cracked to one-fourth open bolls; (2) one-half open bolls; (3) three-fourths open bolls; (4) bolls open but green. Two additional lots of open and green bolls were allowed to dry out in the laboratory for 1 week and 3 weeks, respectively, making altogether six stages in opening and drying. The bolls for each stage of opening were selected separately from the field and tested immediately after gathering.

In tests made upon seeds from partially opened bolls, it is necessary to take into consideration variations in moisture content that would exist between the seeds in the exposed tip and those in the more or less protected base of the lock. It seemed advisable, therefore, to group the seeds according to their position in the lock and determine both the moisture content and the percentage of chipping for each group during each stage of opening. This method should reveal what differences in moisture content existed within the locks at different stages of opening and how greatly these differences affected the amount of chalazal chipping.

In testing, the seeds from the locks selected for any particular test (one stage in opening and drying) were divided into the three described groups representing the tip, middle, and base of the lock. Each group of seeds was placed in a separate air-tight container to prevent the seeds from drying out before testing. When the seeds from all the selected locks had been separated and grouped, the individual seeds were tested for chipping, the results were recorded, and the seeds were completely hand-ginned and returned to their respective air-tight containers. After all the seeds for any one stage of opening and drying had been tested for chipping, moisture determinations were made for the different groups. 5/

5/ These moisture determinations were made according to a standardized distillation process used by the U.S.D.A. experimental ginning laboratory at Stoneville, Miss.

When all the seeds tested for each stage were considered as one group, the percentage of chalazal chipping was found to decrease for both cottons studied with each successive stage of opening and drying (table 9), the decrease in the case of one cotton being from 43.1 percent for bolls one-fourth open to 8.4 percent for bolls open and dried 3 weeks, and in the case of the other cotton, from 44.9 percent to 5.3 percent.

Table 9.--Percentage of chalazal chipping, as determined by hand-ginning tests, for seeds from different stages of opening and drying of the bolls and seeds

Stage of opening and drying of boll	Cotton No. 310		Cotton A	
	Seeds tested	Seeds chipped	Seeds tested	Seeds chipped
	Number	Percent	Number	Percent
1/4 open	310	43.1	797	44.9
1/2 open	857	27.3	1049	36.5
3/4 open	338	16.9	1001	23.6
Open but green	455	12.3	795	20.4
Open and dry	522	9.8	926	19.3
Open and dried 3 weeks	1546	8.4	970	5.3

When the different position groups are considered separately, it will be noticed that, for each position in the lock, there is a gradual decrease in the moisture content of the seeds during opening and drying (table 10). This decrease in moisture content is accompanied, with but few exceptions, by a corresponding decrease in the percentage of seeds that chipped.

For each stage of opening and drying, there are variations in the percentage of seeds that chipped for the different positions in the lock. There is some indication that this variation may be related in part to the moisture content of the seeds, since the moisture content is usually highest in partially dried bolls for the seeds at the base of the lock, and since seeds in this position appear to be more susceptible to chipping than seeds in other positions. But the locks whose seeds have dried to practically the same moisture content throughout still show a greater percentage of chipped seeds at the base of the lock than elsewhere, indicating that the high percentage of chipping for the seeds in the basal position in one-fourth, one-half, and three-fourths open bolls, is not entirely attributable to the high moisture content of the seeds. This suggests the possibility that the position of a seed in

Table 10.--Percentage of chalazal chipping, as determined by hand-testing, and moisture content of seeds at different positions in the lock for 6 stages of opening and drying of bolls and seeds

Cotton lot number	Stages of opening and drying of bolls	Seeds tested			Moisture content of seeds			Seeds chipped at chalazal end		
		Position of seeds in lock			Position of seeds in lock			Position of seeds in lock		
		Tip	Middle	Base	Tip	Middle	Base	Tip	Middle	Base
		Number	Number	Number	Percent	Percent	Percent	Percent	Percent	Percent
310	1/4 open	99	114	97	24.0	28.2	34.3	39.9	39.5	51.5
	1/2 open	289	295	273	17.0	22.8	----	13.1	24.1	34.1
	3/4 open	99	123	106	9.3	18.0	18.1	10.1	14.6	26.4
	Open and green	156	152	147	8.1	9.1	9.7	14.1	4.5	18.4
	Open dried 1 week	169	173	179	7.8	7.5	7.5	4.7	9.2	11.7
	Open dried 3 weeks	522	533	497	----	----	----	5.6	5.2	14.7
A	1/4 open	262	249	286	44.1	46.1	44.4	53.5	37.7	43.4
	1/2 open	421	370	258	36.4	42.4	40.8	38.0	32.7	39.5
	3/4 open	391	359	251	20.1	25.7	28.5	22.0	22.8	26.2
	Open and green	312	281	202	11.4	11.1	12.5	19.2	20.6	23.2
	Open dried 1 week	268	317	341	5.4	6.3	7.2	23.1	14.5	20.8
	Open dried 3 weeks	347	329	244	----	----	----	7.2	3.0	6.6

well-dried locks may be a factor affecting its chipping potentialities and studies that have been made concerning this possibility will be discussed later in this paper.

The results of tests on cotton seeds of different moisture contents indicate, all other things being equal, that the higher the moisture content of a seed, the greater is the possibility that it will chip during testing, and thus very likely during ginning.

Differences in Chipping Potentialities of Seeds from Different Seed Cottons

A wide range of cottons grown in 1934 and 1935 were employed in studying the differences in chipping potentialities of seeds of different varieties and seeds from different positions in the lock.

The 10 cottons tested in 1934 include cottons grown in six different States, representing seven varieties and ranging in staple length from 7/8 inch to 1-3/16 inches. All but two of these cottons (Nos. 301 and 310) were first pickings received at the U.S.D.A. experimental ginning laboratory, Stoneville, Miss. A 1-pound sample was made of each of these cottons by taking handfuls of seed cotton from the wagonlot, after the latter had been thoroughly mixed. Approximately 1-pound samples of seed cotton were made for cottons Nos. 301 and 310 by selecting bolls from the field at a period corresponding to the first picking. From the 1-pound samples thus prepared for each cotton, locks were selected for testing, care being exercised to select entire locks without diseased areas. The seeds of each lock were divided into three groups according to their location at the tip, middle or base of the lock as described previously. Each group of seeds was tested separately and the percentage of chalazal chipping was calculated for each group. From these percentages an average percentage was calculated for the cotton as a whole.

In calculating the average percentage it is necessary to take into account the fact that the number of seeds in each position group are not exactly the same and consequently the three groups of seeds do not represent equal portions of the entire sample. Thus, the average percentage of chipping for each cotton must be weighted by the total number of seeds in each position in the sample.

In 1935 two different groups of cottons were tested. The first group consisted of 14 seed cottons and included cottons grown in several localities, representing 13 varieties and strains and a wide range in staple length. They were from the first pickings of the season. A 1-pound sample of each cotton was taken, as in the previous year. Enough locks were separated into individual seeds to form a mass sample of 3600 seeds unclassified as to position in the lock. From this sample, 10 samples of 100 seeds each were selected for testing. The average percentage of chalazal chipping, as calculated from the 10 tests, was computed for each cotton, as well as the standard deviation and the standard error of the mean for each series of tests.

The second group of cottons tested during 1935 included 16 varieties grown under similar conditions. For each variety, 25 bolls were selected from the growing plants during a period corresponding to the first season picking. The seeds from all the locks from each lot of 25 bolls were divided into the three groups representing seeds from tip, middle, and base of the lock. The percentage of chalazal chipping was calculated for each seed group and for the cotton as a whole.

At the time of testing, the seeds for all the cottons employed in the tests concerning the chipping potentialities of seeds from different seed cottons had dried out in the laboratory for a period of 6 weeks or more and thus all were assumed to have approximately the same moisture content.

The chipping tests made upon 40 different seed cottons show that the seeds from different cottons vary considerably in their chipping tendencies (tables 11, 12, and 13). In one case the percentage of chipping ranges from 1.3 percent to 20.3 percent (table 11), in a second case, from 5.5 percent to 28.1 percent (table 12); and in a third case, from 0.3 percent to 23.3 percent (table 13).

The data presented in tables 11 and 13 were subjected to analysis of variance to ascertain whether there were significant differences in chipping tendencies among these cottons. The F value obtained for means of cottons was considerably larger than that needed for significance (table 13) - indicating that there are significant differences among these particular seed cottons in their tendencies to chip.

Fisher's formula for comparing means-- $t = \dfrac{m_1 - m_2}{\sqrt{(\sigma m_1)^2 + (\sigma m_2)^2}}$ -- was applied to the data in table 12. The mean for each cotton was compared separately with the mean for every other cotton. Those means that differed significantly at odds of 99:1 are indicated by the crossed squares in figure 2. Cotton 469, with the lowest percentage of chipping, is seen to differ significantly from 10 of the other cottons, and cotton 438, with the highest percentage, differs from 10 of the others.

Variance analysis of the data from which the means presented in table 12 were obtained indicate highly significant differences in the percentage of chalazal chipping among these particular seed cottons. An F value of 22.68 was obtained, whereas values of only 1.83 (5%) or 2.33 (1%) were needed for significance.

Although the cottons represented in tables 11 and 12 include a number of different varieties, the variations in chipping percentage cannot, in these cases, be considered to represent varietal differences only. All of these cottons were not grown under similar environmental conditions and this fact introduces the possibility that part of the variation in susceptibility to chalazal chipping among these cottons may result from differences in the environments of the growing plants.

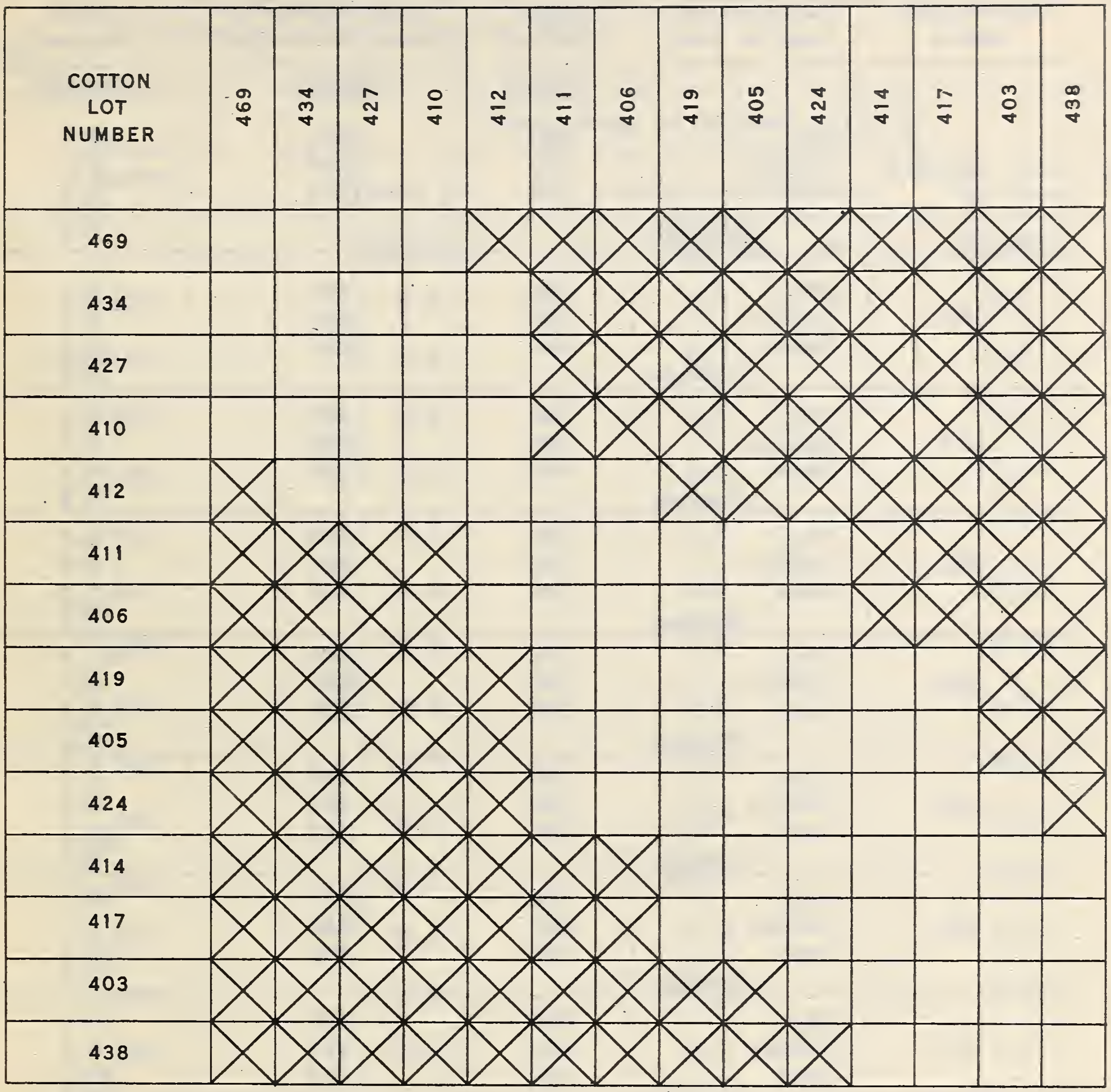

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Figure 2.—Those of 14 different seed cottons that differ significantly in percentage of chalazal chipping.

The figure is based on data presented in table 12. Each cross-lined square indicates that the two cottons concerned differ at odds of 99 to 1 as measured by Fisher's formula $t = \dfrac{m_1 - m_2}{\sqrt{(\sigma m_1)^2 + (\sigma m_2)^2}}$; **N = 18.**

Table 11.--Percentage of seeds that chipped at the chalazal end during hand-testing for 10 seed cottons grown in 1934.

Cotton lot number	Position of seed in lock	Seeds tested	Total number of seeds in sample	Seeds chipped 1/
		Number	Number	Percent
311	Tip	300	1004	0.7
	Middle	300	1083	1.0
	Base	300	1073	2.3
	Average			1.3
323	Tip	300	867	2.3
	Middle	300	1039	1.7
	Base	300	1057	4.3
	Average			2.8
314	Tip	300	782	2.0
	Middle	600	1610	3.7
	Base	300	628	6.7
	Average			3.9
325	Tip	375	632	5.5
	Middle	375	613	2.8
	Base	375	618	7.2
	Average			5.2
305	Tip	375	1052	11.9
	Middle	375	1039	4.7
	Base	375	1009	7.7
	Average			8.1
310	Tip	300	522	5.6
	Middle	300	533	5.2
	Base	300	497	14.7
	Average			8.4
301	Tip	300	1073	12.7
	Middle	300	1163	6.1
	Base	300	955	10.4
	Average			9.6
317	Tip	250	385	14.4
	Middle	500	944	6.9
	Base	250	482	20.0
	Average			12.0
353	Tip	375	660	14.9
	Middle	375	675	11.1
	Base	375	674	19.8
	Average			15.3
307	Tip	375	656	18.8
	Middle	375	662	16.4
	Base	375	669	25.6
	Average			20.3

1/ Average percentage for each cotton was weighted by the total number of seeds in each position in the sample.

Table 12.--Mean percentage, standard deviation, and standard error of the mean for seeds that chipped at the chalazal end during hand-ginning tests for 14 different cottons grown in 1935

Cotton lot number	Percentage of chipped seeds 2/		
	Mean 1/	Standard deviation	Standard error of the mean
	Percent	Percent	Percent
469	5.5	2.6	0.8
434	6.4	2.7	0.9
437	6.5	2.4	0.8
410	8.0	2.8	0.9
412	9.8	3.3	1.1
411	11.8	2.4	0.8
406	13.2	3.7	1.2
419	15.0	3.3	1.1
405	15.3	3.9	1.3
424	16.3	5.0	1.6
414	20.7	6.7	2.1
417	21.8	8.2	2.6
403	24.0	7.6	2.4
438	28.1	5.5	1.7

1/ Mean of 10 tests of 100 seeds each

2/ Results of analysis of variance: for means of cottons - F found = 22.68; F needed = 1.83 (5%) or 2.33 (1%)

Table 13.--Percentage of seeds that chipped at the chalazal end during hand-testing for 16 different varieties grown on adjacent plots at Stoneville, Miss., in 1935

Variety	Position of seed in the lock	Seeds tested	Seeds chipped 1/
		Number	Percent
Wilds #5	Tip	375	0.5
	Middle	375	0.0
	Base	391	0.3
	Average		0.3 2/
Qualla	Tip	375	0.4
	Middle	375	1.6
	Base	460	3.8
	Average		1.9
Delfos #4	Tip	250	2.5
	Middle	300	2.6
	Base	295	5.0
	Average		3.2
Acala (Rogers)	Tip	375	5.6
	Middle	375	3.2
	Base	351	9.2
	Average		5.9
Farm Relief #2	Tip	250	8.0
	Middle	500	5.9
	Base	289	9.6
	Average		7.4
Cleveland (Wan.)	Tip	375	8.8
	Middle	375	3.7
	Base	335	11.2
	Average		7.7
Arkansas #17	Tip	250	9.2
	Middle	500	6.9
	Base	285	16.3
	Average		9.8
Deltapine	Tip	250	11.6
	Middle	500	9.0
	Base	285	13.1
	Average		10.7
Dixie Triumph #759	Tip	250	20.8
	Middle	500	5.8
	Base	315	15.2
	Average		12.0

Continued

Table 13.-- Percentage of seeds that chipped at the chalazal end during hand-testing for 16 different varieties grown on adjacent plots at Stoneville, Miss., in 1935--Continued

Variety	Position of seed in the lock	Seeds tested	Seeds chipped 1/
		Number	Percent
Stoneville #5	Tip	250	13.3
	Middle	500	10.3
	Base	310	17.5
	Average		12.9 2/
Mexican Big Boll	Tip	250	20.0
	Middle	500	12.3
	Base	256	11.4
	Average		13.5
Half and Half	Tip	375	23.4
	Middle	375	16.7
	Base	408	23.3
	Average		21.1
Startex #619	Tip	375	20.9
	Middle	375	18.2
	Base	416	25.0
	Average		21.3
Cook #912	Tip	375	29.3
	Middle	375	13.2
	Base	400	25.1
	Average		22.4
Rowden #2088	Tip	375	25.4
	Middle	375	19.4
	Base	405	23.9
	Average		22.8
Oklahoma Triumph #44	Tip	375	26.3
	Middle	375	20.3
	Base	339	23.5
	Average		23.3

1/ Results of analysis for combined data of tables 11 and 13: for means of cottons - F found = 19.37 - F needed = 1.74 (5%) or 2.18 (1%); for means of positions - F found = 25.73 - F needed = 3.18 (5%) or 5.06 (1%)

2/ Average percentage for each cotton was weighted by the number of seeds in each position

The second group of 1935 cottons, however, includes 16 varieties grown on adjoining plots and, thus, under what could be considered to be similar environmental conditions. These 16 varieties differed decidedly in the percentage of seeds that chipped during testing (table 13). In fact, the range in percentage of chipping shown by this group is slightly greater than that exhibited by either of the other groups. Since these varieties were grown under similar conditions, the variations in chipping percentages may, in this particular instance, be considered to represent differences in the chipping potentialities of the seeds of these varieties.

Differences in Chipping Potentialities of Seeds from Different Positions in the Lock

Twenty-six cottons (10 (1934) + 16 (1935)) were tested for chalazal chipping in such a way as to ascertain whether there are consistent tendencies among different cottons for seeds at certain positions in the lock to be more susceptible to chalazal chipping than seeds at other positions.

In general, seeds at the base of the lock appear to be most susceptible to chalazal chipping. For all but one cotton tested, the percentage of chipping for the basal group of seeds was larger than for the middle group; and in 18 out of 26 cottons, the percentage for the basal group was larger also than the percentage for the group at the tip of the lock; (figs. 3 and 4).

Seeds in the middle of the lock seem to be less susceptible to chalazal chipping than seeds in either the tip or the base of the lock, but there were instances in which the percentage of chipping for seeds at the tip of the lock was smaller than for seeds in the middle of the lock. The cottons, in these instances, were usually ones whose total percentage of chipping was low.

Analysis of variance of the combined data of tables 11 and 13 gave, for means of position, an F value that greatly exceeded that needed for significance (table 13), indicating that there are highly significant differences in the chipping potentialities of seeds from different positions in the lock. Thus, the position a seed occupies in the lock is a factor affecting the possibility that it may chip at the chalazal end during ginning.

SUMMARY

Practically all ginned lint contains seed-coat fragments, but the quantity of this foreign matter varies greatly with lint from different seed cottons.

Seed-coat fragments are undesirable because they constitute waste that should be removed during manufacturing. But seed-coat fragments with tufts of fibers still attached to them are particularly difficult to remove from the lint. Those small fragments that are not eliminated during the manufacturing process may form imperfections in the yarn and lower its quality.

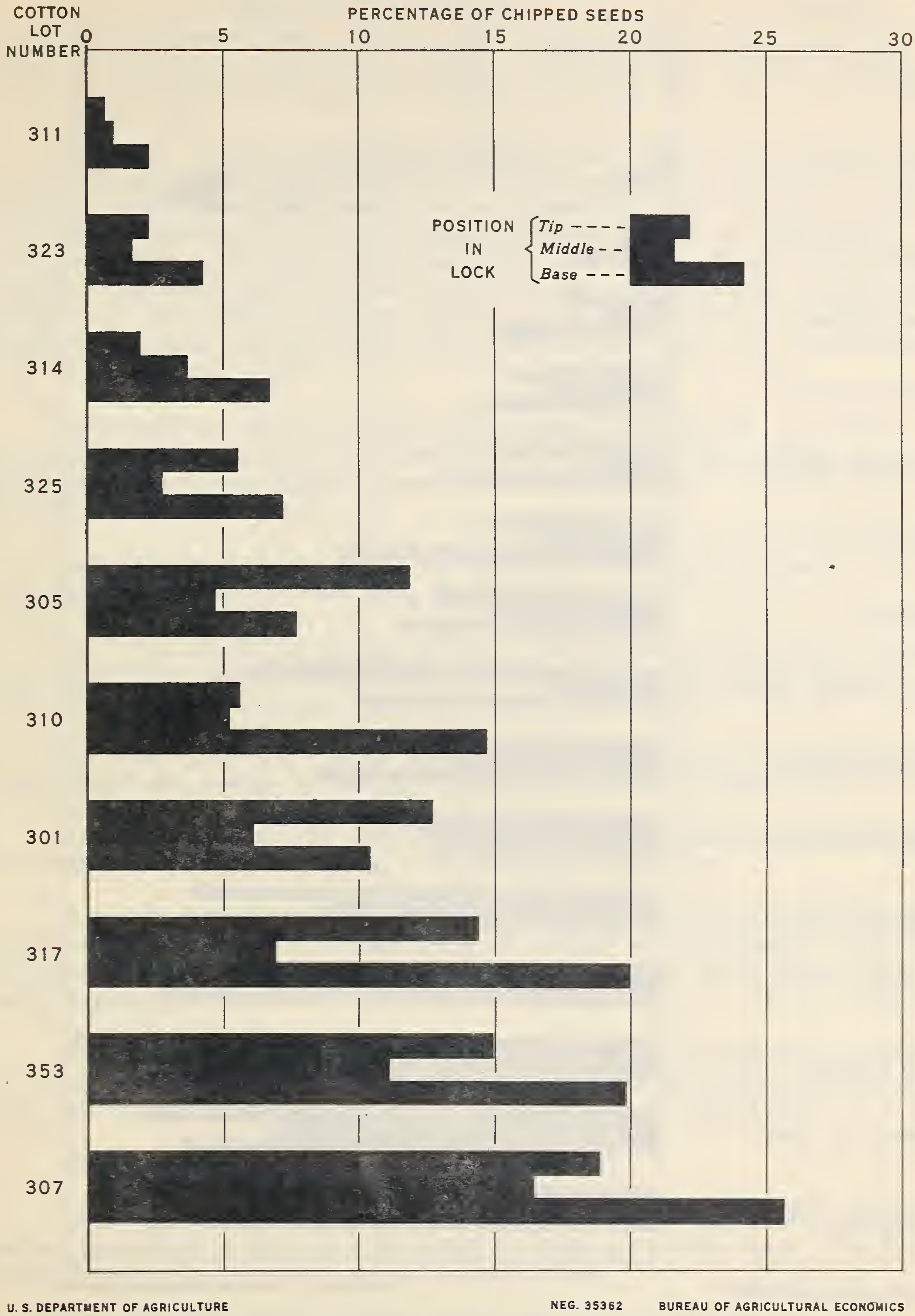

Figure 3.--Percentage of seeds at different positions in the lock that chipped at the chalazal end during hand-testing for ten seed cottons grown in 1934.

In general, seeds at the base and tip of the lock have a greater tendency to chip than seeds in the middle of the lock.

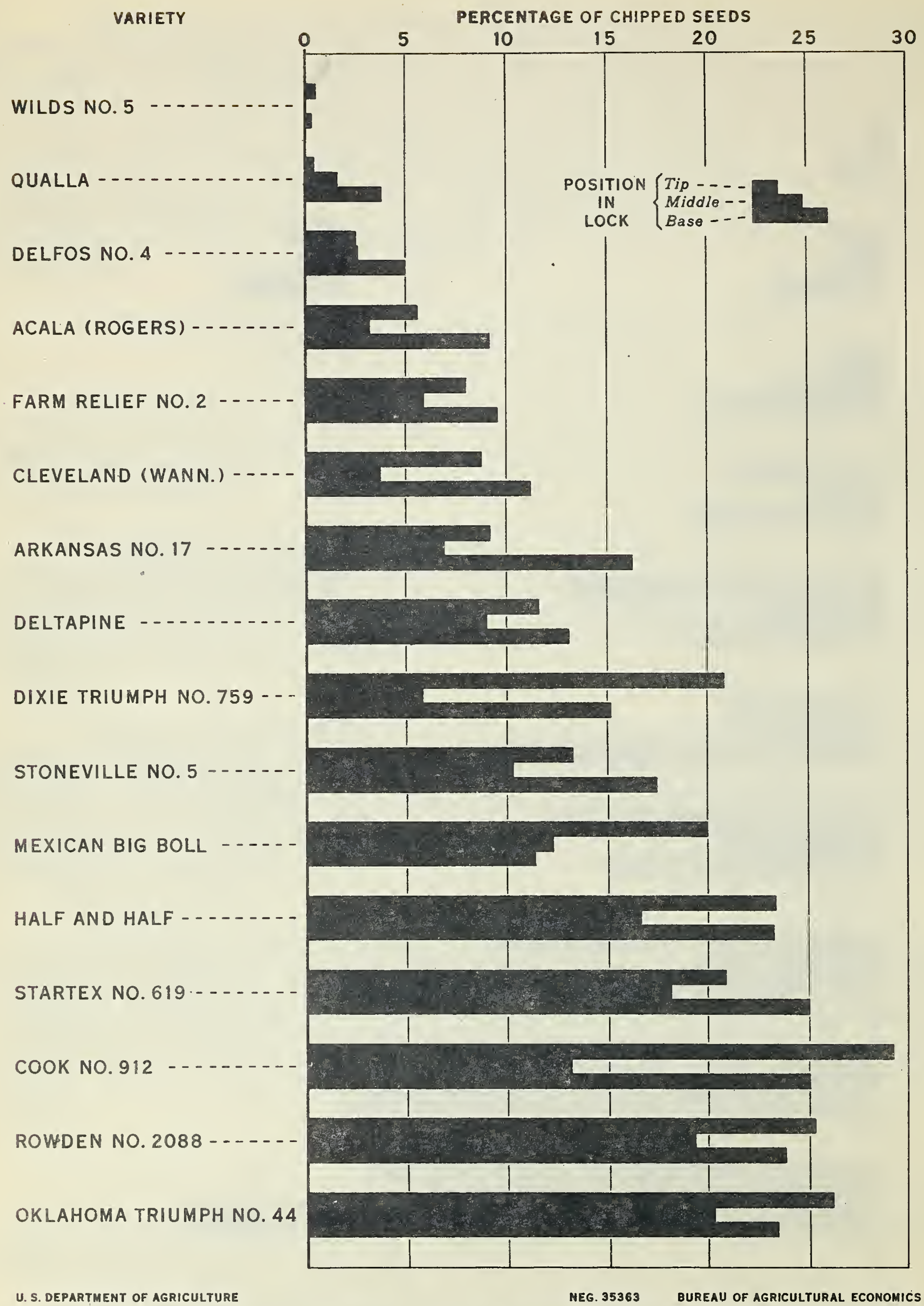

Figure 4.—Percentage of seeds at different positions in the lock that chipped at the chalazal end during hand-testing for sixteen different varieties grown on adjacent plots at Stoneville, Miss., in 1935.

In general, seeds at the tip and base of the lock have a greater tendency to chip than seeds in the middle of the lock.

Seed-coat fragments in ginned lint are from two sources--motes and seeds. A large percentage of the seed fragments are from a definite region of the seed--namely, the chalazal end--and the factors affecting their occurrence in the lint are peculiar to them.

Some few of these chalazal fragments, as found in the ginned lint, are small, but the ones under consideration are those definitely larger seed-coat particles that consist of a fragment of dark-colored, brittle seed coat to which most of the fibers which grew from it are still attached. The seed-coat portion consists of a fragment of the epidermis, together with some of the tissue from the underlying spongy layer. The presence of the ragged, spongy cells usually will serve to identify a chalazal fragment, since these cells are characteristic of the chalazal portion of the seed coat.

Observations seem to indicate that many, if not all, of these chalazal fragments present in saw-ginned lint, have been pulled from the seeds during the ginning process rather than cut off by blows from the teeth of the gin saw.

Data obtained by counting the number of chalazal fragments in 1-1/2-ounce samples of lint show that:

1. As a result of drying green or damp seed cotton before ginning, lint is produced that contains fewer chalazal fragments than occur in lint from the same seed cotton ginned without drying.

2. The tightness of the seed roll does not have a significant effect upon the number of chalazal fragments in the ginned lint.

3. The speed of the saws apparently has no consistent effect upon the number of chalazal fragments occurring in the lint.

A technique of hand-testing the chipping potentialities of cotton seeds was developed. If a seed chipped during the treatment, this behavior was considered to indicate the possibility that that seed might chip during machine-ginning.

The technique of hand-testing was used to study the differences in the chipping potentialities of seeds of different moisture contents; seeds from different varieties; and seeds from different positions in the lock.

These studies gave the following results:

(1) Hand chipping tests on seeds of different moisture contents demonstrated that the lower the moisture content of the seed, the less likely will it be to chip at its chalazal end.

(2) Studies on 26 cottons showed that seeds in the base of the lock had a greater tendency to chip than seeds in the middle; and that in many instances, particularly with cottons having a high percentage of chipping, the seeds in the tip of the lock had a greater tendency to chip than seeds in the middle of the lock.

(3) A total of 40 different seed cottons representing several different varieties, strains, and localities, showed a range in the percentage of chalazal chipping from 0.3 percent to 28.1 percent. Since all of the cottons were not grown under similar environmental conditions, the differences in the chipping percentages cannot be considered to represent varietal differences alone.

However, of the 40 cottons tested, 16 were distinct varieties and were grown under similar environmental conditions. These 16 cottons showed a range in percentage of chalazal chipping from 0.3 percent to 23.3 percent. Since these cottons were grown under similar conditions, it may be concluded that in this instance and at this location, the differences in percentage of chalazal chipping represent differences in chipping potentialities of these 16 varieties.

Thus it is apparent that the likelihood that any particular seed will chip at its chalazal end during ginning depends, among other possible, unstudied factors, upon: (1) the variety to which it belongs; (2) the position it occupied in the lock; and (3) the moisture content at the time of ginning, which in turn may depend upon (a) the length of time the boll had been opened when harvested, (b) the position the seed occupied in the lock, if the lock is not completely dried, (c) the time of harvesting in relation to rain or dew, and (d) the extent to which it was allowed to dry before ginning.

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APPENDIX

Covariance analysis of number of chalazal fragments in lint ginned from seed cotton of high and of low moisture content for each of 14 different seed cottons (table 4 - only loose seed roll data considered)

Source of variation	Degrees of freedom	Percentage of moisture		Chalazal fragments		Covariance			Significant values of r	
		Sum of squares	Mean square	Sum of squares	Mean square	Sum of products	Correlation coefficient	Regression	5%	1%
Total	27	638.75	23.66	42711.43	1581.90	3842.01	0.7356			
Between cottons	13	224.91	17.30	23694.43	1822.65	1262.51	.5469	5.61	0.532	0.661
Within cottons	14	413.84	29.56	19017.00	1358.36	2579.50	.9195	6.23	.514	.641

Analysis of variance of number of chalazal fragments in lint ginned with a loose and with a tight seed roll (tables 4 and 6)

Source of variation	Degrees of freedom	Sum of squares	Mean square	F found	F needed	
					5%	1%
Total	59	50160.60				
Seed roll densities	1	77.06667	77.06667	1.99	250.00	6258.00
Cottons	29	45631.60000	1578.50345	10.24	1.85	2.41
Remainder	29	4451.93333	153.51494			

Analysis of variance of percentage of chalazal chipping for seeds of different seed cottons and for seeds at different positions in the lock (tables 11 and 13)

Source of variation	Degrees of freedom	Sum of squares	Mean square	F found	F needed	
					5%	1%
Total	77	4847.00872				
Positions	2	435.79564	212.89782	25.73	3.18	5.06
Cottons	25	4007.46205	160.29848	19.37	1.74	2.18
Remainder	50	413.75103	8.27502			

Analysis of variance of percentage of chalazal chipping for 14 different cottons (table 12)

Source of variation	Degrees of freedom	Sum of squares	Mean square	F found	F needed	
					5%	1%
Total	139	9348.74286	67.25714			
Between cottons	13	6549.74286	503.82637	22.68	1.83	2.33
Within cottons	126	2799.00000	22.21429			